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Dr. Brian Litt and Liberty Simons with an epilepsy patient at the Hospital of the University of Pennsylvania. Experts hope their research will lead to a cure for seizures.

## Doctors Look Ahead to 'Pacemakers for the Brain'

By LINDA CARROLL

While some scientists try to tease out the mechanics of susceptibility to seizures, others seek ways to predict them and head them off.

Aided by smaller and faster computers, researchers say they will soon be able to predict seizures and to design tiny implantable devices that will interrupt them with jolts of electricity or tiny squirts of medication directly into the brain.

Until recently, scientists thought that seizures came on suddenly, with no warning. But new research has shown that seizures start with a tiny spark of activity and that they take hours to build to a surge.

"Seizures develop over time," said Dr. Brian Litt, an assistant professor of neurology at the University of Pennsylvania. "They don't just strike you like lightning."

After researchers realized how slowly seizures developed, they decided to study recordings of brain waves, electroencephalographs, to see whether they could discern any precursors.

As it turns out, scientists had a ready source of EEG's that had been gathered from epilepsy patients who went to hospitals for surgery.

All of the patients scheduled for surgery to remove damaged, seizing brain tissues have their brain waves recorded for several days.

When researchers looked at these recordings with standard analyses, they could not find any warning signs before seizures.

Then the scientists started using methods that are derived from chaos theory, and the seizure patterns started to become clear.

In December, researchers from Arizona State University showed that they could predict more than 80 percent of seizures with a computer program using chaos theory that analyzed brain waves.

On average, warnings of impending surges occurred more than an hour before the seizure, said Dr. Leo D. Inesmidis, an associate professor of bioengineering.

The process is not perfect, though. The computer periodically issued false alarms.

Such research could eventually lead to a "cure" for seizures, Dr. Inesmidis said, adding, "We envision a device that would automatically release a very low dose of an anti-epilepsy drug or an electrical signal that would block the seizure."

Dr. Litt and Dr. Inesmidis said "pacemakers for the brain" were a few years away.

Dr. Litt added: "Devices that react to the electrical start of a seizure, before the onset of overt clinical symptoms, are actually in early testing in humans now."

"But they have a fair amount of development to go. Devices to predict the onset and then trigger therapy are likely a few years away."